V. CLAIMS

What is claimed is:

1. A chimeric protein comprising:

   a protein transduction domain; and

   a deaminase domain, wherein the deaminase edits viral RNA.

2. The chimeric protein of claim 1, wherein the protein transduction domain is selected from the group consisting of poly-arginine, poly-lysine peptide, third alpha helix of Antennapedia homeodomain protein, HSV-1 virion protein (VP) 22, HIV-1 Vpr, and HIV TAT protein.

3. The chimeric protein of claim 2, wherein the protein transduction domain is an HIV Tat domain.

4. The chimeric protein of claim 3, wherein the Tat domain comprises SEQ ID NO: 43.

5. The chimeric protein of claim 1, wherein the deaminase domain comprises CEM15.

6. The chimeric protein of claim 5, wherein the CEM15 domain comprises SEQ ID NO: 1.

7. The chimeric protein of claim 5, wherein the deaminase domain is a fragment or derivative of CEM15 having deaminase function.

8. The chimeric protein of claim 7, wherein the CEM15 fragment or derivative has at least 70% amino acid similarity with CEM15.

9. The chimeric protein of claim 1, further comprising an epitope tag.

10. The chimeric protein of claim 9, wherein the epitope tag is hemagglutinin.

11. The chimeric protein of claim 1, further comprising a polyhistidine tag.

12. The chimeric protein of claim 1, further comprising a polypeptide domain that enhances solubility of the chimeric protein.

13. The chimeric protein of claim 12, wherein the polypeptide domain is a chicken muscle pyruvate kinase.

14. The chimeric protein of claim 13, wherein the chicken muscle pyruvate kinase comprises the amino acid sequence of SEQ ID NO: 41.

15. The chimeric protein of claim 1, further comprising a protein cleavage site.

16. A chimeric protein comprising

a protein transducing domain; and

a deaminase domain that edits DNA.

17. The chimeric protein of claim 16, wherein the deaminase domain edits viral DNA.

18. The chimeric protein of claim 16, wherein the deaminase is a cytidine deaminase.

19. A chimeric protein comprising

a protein transducing domain; and

a deaminase domain, wherein the deaminase is not APOBEC-1.

20. The chimeric protein of claim 19, wherein the deaminase has less than 70% amino acid similarity with APOBEC-1.

21. The chimeric protein of claim 19, wherein the deaminase has more than 70% amino acid similarity with Cem15.

22. A chimeric protein comprising

a protein transducing domain; and

a deaminase, wherein the deaminase does not edit ApoB1 mRNA.

23. A chimeric protein comprising

a protein transducing domain; and

a deaminase domain, wherein the deaminase comprises more than two CTD-1 repeats.

24. The chimeric protein of claim 23, wherein more than one of the CTD-repeats has a deaminating function.

25. A chimeric protein comprising

a protein transducing domain;

a deaminase domain, wherein the deaminase comprises a CTD-1; and

an anchor oligonucleotide.

26. A CEM15 mimetic, wherein the mimetic binds viral infectivity factor.

27. A chimeric protein comprising

a protein transducing domain; and

the CEM15 mimetic of claim 25.

28. A method of interrupting HIV infectivity comprising contacting an HIV-infected cell or a cell prior to HIV infection with the chimeric protein of claim 1, under conditions that allow delivery of the chimeric protein into the cell, wherein the chimeric protein binds with vif to interrupt HIV infectivity.

29. A method of treating a subject with an HIV infection or at risk for an HIV infection comprising administering to the subject an effective amount of the chimeric protein of claim 1.

30. The method of claim 28, wherein the administration step is dose-dependent.

31. The method of claim 28, wherein the administration step is transient.

32. The method of claim 28, further comprising administering to the subject an agent that enhancing the efficiency of mRNA editing function of the chimeric protein.

33. An isolated nucleotide sequence that encodes the chimeric protein of claim 1.

34. A vector comprising the nucleotide sequence of claim 33.

35. A recombinant host cell comprising the vector of claim 34.

36. A composition comprising the chimeric protein of claim 1 and a pharmaceutical carrier.

37. A method of screening for a viral RNA deaminase mimetic comprising adding the agent to be screened to a virally infected mammalian system; and detecting levels of edited viral RNA, elevated levels of edited viral RNA indicating a viral RNA deaminase mimetic.

38. The method of claim 37, wherein the virus is a retrovirus.

39. The method of claim 38, wherein the retrovirus is HIV.

40. The method of claim 37, wherein the viral RNA deaminase mimetic is a CEM15 mimetic.

41. The method of claim 37, further comprising detecting binding of the agent to be screened to a virion infectivity factor.

42. A method of screening for a viral DNA deaminase mimetic comprising adding the agent to be screened to a virally infected mammalian system; and detecting levels of edited viral DNA, elevated levels of edited viral RNA indicating a viral RNA deaminase mimetic.

43. The method of claim 42, wherein the virus is a retrovirus.

44. The method of claim 43, wherein the retrovirus is HIV.

45. The method of claim 42, wherein the viral DNA deaminase mimetic is a CEM15 mimetic.

46. The method of claim 42, further comprising detecting binding of the agent to be screened to a viral integration factor.

47. A chimeric protein comprising:

a first polypeptide comprising a protein transduction domain; and

a second polypeptide comprising Activation Induced Deaminase or a fragment thereof which can deaminate cytidine to form uridine in an mRNA molecule or deaminate cytidine to form thymidine in a DNA molecule.

48. The chimeric protein according to claim 47 wherein the protein transduction domain is selected from the group consisting of poly-arginine, poly-lysine peptide, third alpha helix of Antennapedia homeodomain protein, HSV-1 virion protein (VP) 22, HIV-1 Vpr, and HIV TAT protein.

49. The chimeric protein of claim 48, wherein the protein transduction domain is an HIV Tat domain.

50. The chimeric protein according to claim 48, wherein the HIV TAT protein transduction domain comprises an amino acid sequence of SEQ ID NO: 43.

51. The chimeric protein according to claim 47 wherein the AID or fragment thereof comprises an amino acid sequence of SEQ ID NO: 3 or fragments thereof.

52. The chimeric protein of claim 51, wherein the AID fragment or derivative has at

least 70% amino acid similarity with SEQ ID NO: 3.

53. The chimeric protein according to claim 47 further comprising:
a third polypeptide comprising a cytoplasmic localization protein or a fragment thereof which enhances localization of the chimeric protein to the cytoplasm.

54. The chimeric protein according to claim 53 wherein the cytoplasmic localization protein or fragment thereof is chicken muscle pyruvate kinase or a fragment thereof.

55. The chimeric protein according to claim 54 wherein the chicken muscle pyruvate kinase or a fragment thereof comprises an amino acid sequence of SEQ ID NO: 41 or fragments thereof.

56. The chimeric protein of claim 53, wherien the third polypeptide enhances solubility.

57. The chimeric protein according to claim 53 wherein, within the chimeric protein, the third polypeptide is C-terminal of the second polypeptide.

58. The chimeric protein of claim 47, further comprising an epitope tag.

59. The chimeric protein of claim 55, wherein the epitope tag is hemagglutinin.

60. The chimeric protein according to claim 47 further comprising a polyhistidine tag.

61. The chimeric protein according to claim 47, wherein the chimeric protein comprises an amino acid sequence of SEQ ID NO: 3.

62. The chimeric protein according to claim 1, wherein the chimeric protein is in isolated form.

63. A composition comprising:
a pharmaceutically acceptable carrier and
the chimeric protein according to claim 47.

64. The composition according to claim 63, wherein the chimeric protein is present in an amount which is effective to edit mRNA or deaminate cytidines in DNA of B lymphoblastic or any cells in which mRNA or DNA will serve as a substrate for the enzyme and which uptake the chimeric protein.

65. The composition according to claim 63, wherein the composition is in the form

of a tablet, capsule, powder, solution, suspension, or emulsion.

66. A nucleic acid molecule encoding the chimeric protein according to claim 1.

67. The nucleic acid molecule according to claim 66, wherein the nucleic acid is DNA.

68. The nucleic acid molecule according to claim 66, wherein the nucleic acid is RNA.

69. An expression vector comprising the nucleic acid molecule according to claim 66.

70. The expression vector according to claim 66, wherein the expression vector is operable in prokaryotic cells.

71. A recombinant host cell comprising the expression vector according to claim 66.

72. A recombinant host cell comprising the nucleic acid molecule according to claim 66.

73. A DNA construct comprising:

the DNA molecule according to claim 67;

a promoter sequence operably connected 5' to the DNA molecule; and

a 3' regulatory sequence operably connected 3' of the DNA molecule.

74. An expression vector comprising the DNA construct according to claim 24.

75. The expression vector according to claim 70, wherein the expression vector is operable in prokaryotic cells.

76. A recombinant host cell comprising the expression vector according to claim 70.

77. A recombinant host cell comprising the DNA construct according to claim 69.

78. An isolated B lymphoblastic cell or other receptive cell which has taken up the chimeric protein according to claim 47.

79. A method of inducing production of immunoglubulins of the various classes

and their subtypes comprising:

contacting a B lympohoblast with the chimeric protein according to claim 1 under conditions effective to cause cellular uptake of the chimeric protein, and thereby induce antibody production in the B lymphoblast.

80. The method according to claim 79 wherein the B lymphoblast is *in vitro*.

81. The method according to claim 79 wherein the B lymphoblast is *in vivo*.

82. The method according to claim 79 wherein the antibody production includes IgG production.

83. The method according to claim 79 wherein the antibody production includes IgA production.

84. The method according to claim 79 wherein the antibody production includes IgE production.

85. The method according to claim 80 wherein the chimeric protein comprises an amino acid sequence of SEQ ID NO: 3.

86. A method of inducing class switch recombination in a B lymphocyte cell comprising:

contacting a B lymphocyte cell with the chimeric protein according to claim 47 under conditions effective to cause cellular uptake of the chimeric protein, and thereby induce class switch recombination during antibody production in the B lymphocyte cell.

87. The method according to claim 86 wherein the B lymphocyte cell is *in vitro*.

88. The method according to claim 86 wherein the B lymphocyte cell is *in vivo*.

89. The method according to claim 86 wherein the chimeric protein comprises an amino acid sequence of SEQ ID NO: 3.

90. The method according to claim 86 wherein the B lymphocyte cell, prior to said contacting, is deficient in an ability to exhibit class switch recombination during antibody production.

91. The method according to claim 86 wherein the B lymphocyte cell, prior to said

contacting, exhibits normal levels of class switch recombination during antibody production.

92. A method of inducing somatic hypermutation in a B lymphocyte cell comprising:

contacting a B lymphocyte cell with the chimeric protein according to claim 1 under conditions effective to cause cellular uptake of the chimeric protein, and thereby induce somatic hypermutation during antibody production in the B lymphocyte cell.

93. The method according to claim 92 wherein the B lymphocyte cell is *in vitro*.

94. The method according to claim 92 wherein the B lymphocyte cell is *in vivo*.

95. The method according to claim 92 wherein the chimeric protein comprises an amino acid sequence of SEQ ID NO: 3.

96. The method according to claim 92 wherein the B lymphocyte cell, prior to said contacting, is deficient in an ability to exhibit somatic hypermutation during antibody production.

97. The method according to claim 92 wherein the B lymphocyte cell, prior to said contacting, exhibits normal levels of somatic hypermutation during antibody production.

98. A method of inducing an immune response in response to an antigen in a subject comprising:

contacting a B lymphocyte cell with the chimeric protein according to claim 1 under conditions effective to cause cellular uptake of the chimeric protein, and thereby induce antibody production in the B lymphocyte cell to afford a stronger immune response to an antigen in the subject.

99. The method according to claim 98 wherein said contacting is carried out *in vitro*, said method further comprising:

introducing the B lymphocyte cell into the subject.

100. The method according to claim 98 wherein said contacting is carried out *in vivo*.

101. The method according to claim 98 wherein the antibody production includes

IgG production.

102. The method according to claim 98 wherein the antibody production includes IgA production.

103. The method according to claim 98 wherein the antibody production includes IgE production.

104. The method according to claim 98 wherein the chimeric protein comprises an amino acid sequence of SEQ ID NO: 3.

105. A method of treating a subject for hyper-IgM syndrome comprising:

administering to a subject exhibiting hyper-IgM syndrome an effective amount of a chimeric protein according to claim 1, wherein the chimeric protein taken up by B lymphocyte cells induces antibody production sufficient to treat the hyper-IgM syndrome.

106. The method according to claim 105 wherein said administering is carried out orally, topically, transdermally, parenterally, subcutaneously, intravenously, intramuscularly, intraperitoneally, by intracavitary or intravesical instillation, intraocularly, intraarterially, intralesionally, by application to mucous membranes, or by implantation.

107. The method according to claim 105 wherein the antibody production includes IgG production.

108. The method according to claim 105 wherein the antibody production includes IgA production.

109. The method according to claim 105 wherein the antibody production includes IgE production.

110. The method according to claim 105 wherein the chimeric protein comprises an amino acid sequence of SEQ ID NO: 3.

111. A method of treating a subect for hyper-IgM syndrome comprising:

administering to a subject exhibiting hyper-IgM syndrome a population of B lymphocyte cells according to claim 78, wherein the administered B lymphocyte cells exhibit antibody production sufficient to treat the hyper-IgM syndrome.

112. The method according to claim 111 wherein said administering is carried out intravenously, intramuscularly, or intraarterially.

113. The method according to claim 111 wherein the antibody production includes IgG production.

114. The method according to claim 111 wherein the antibody production includes IgA production.

115. The method according to claim 111 wherein the antibody production includes IgE production.

116. The method according to claim 111 further comprising prior to said administering:

removing the population of B lymphocyte cells from the subject and exposing the B lymphocyte cells to the chimeric protein under conditions effective to cause cellular uptake of the chimeric protein.

117. The method according to claim 111 wherein the chimeric protein comprises an amino acid sequence of SEQ ID NO: 3.

118. A method of treating a subject for B lymphocyte cell lymphoma comprising:

administering to a subject exhibiting B lymphocyte cell lymphoma an effective amount of a chimeric protein according to claim 1, wherein the chimeric protein taken up by cancerous B lymphocyte cells, and inhibits blunt cell growth thereof, thereby treating the lymphoma.

119. The method according to claim 118 wherein said administering is carried out orally, topically, transdermally, parenterally, subcutaneously, intravenously, intramuscularly, intraperitoneally, by intracavitary or intravesical instillation, intraocularly, intraarterially, intralesionally, by application to mucous membranes, or by implantation.

120. The method according to claim 118 wherein the chimeric protein comprises an amino acid sequence of SEQ ID NO: 3.

121. A delivery device comprising a chimeric protein according to claim 1.

122. The delivery device according to claim 121, wherein the delivery device is in

the form of a liposome, a niosome, a transdermal patch, an implant, or a syringe.

123. A delivery device comprising a composition according to claim 63.

124. The delivery device according to claim 123, wherein the delivery device is in the form of a liposome, a niosome, a transdermal patch, an implant, or a syringe.